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Facilities Evaluation of High Efficiency Boiler Destruction PCB Waste

TRW, Inc.
Redondo Beach, CA

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

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FACILITIES EVALUATION OF HIGH EFFICIENCY BOILER DESTRUCTION PCB WASTE

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ABSTRACT

A rendering plant byproduct, yellow grease, was found to be contaminated by PCB's from a transformer leak. The PCB content (under 500 ppm) determines the method of disposal under 40 CFR Part 761. For this evaluation, destruction in a high efficiency boiler was evaluated as an alternative to landfill disposal. The process steam boiler belonging to the waste owner, Seattle Rendering Works, was evaluated as a candidate site for waste destruction. The logistics and fuel handling requirements were found to be feasible to set up in a short time, and the boiler size and residence time were determined to be likely to allow high destruction efficiency. With 99.9% destruction of PCB's, the downwind concentration was estimated by diffusion modeling to be less than OSHA limits for industrial exposure. Fuel characteristics of the yellow grease were used to support the recommendation for 100% grease fired as fuel.

A second high-efficiency boiler candidate was also evaluated. The Shuffleton power plant, operated by Puget Sound Power & Light Company, operates three boilers from a common oil fuel supply system. The size and facilities at this site were determined to satisfy all the prerequisites for high efficiency boilers (40 CFR Part 761), and to best be operated by blending the waste with the normal fuel oil supply. A 30% waste blend was evaluated and found to be completely miscible and feasible with respect to logistical support.

A verification test burn was recommended and outlined for either candidate site. Current EPA protocol and policy developments for PCB destruction were found to be appropriate for the preparation of a candidate facility test poan and an example public notice.

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16. ABSTRACT: The report gives results of an evaluation of destruction in two different high-efficiency boilers (as an alternative to landfill disposal) of waste (a rendering plant byproduct, yellow grease) found to be contaminated by PCBs from a transformer leak. (The PCB content--under 500 ppm--determines the disposal method under 40 CFR Part 761.) At the first boiler: (1) logistics and fuel handling requirements were found to be feasible to set up in a short time; (2) boiler size and residence time were determined to be likely to allow high destruction efficiency; (3) with 99.9% destruction of PCBs, downwind concentration was estimated to be less than OSHA limits for industrial exposure; and (4) fuel characteristics of the yellow grease were used to support the recommendation for 100% grease fired as fuel. At the second boiler: (1) the size and facilities were determined to satisfy all prerequisites for high efficiency boilers (40 CFR Part 761); (2) best operation was by blending the waste with the normal fuel oil supply; and (3) a 30% waste blend was found to be completely miscible and feasible with respect to logistical support. A verification test burn was recommended and outlined for either candidate site. Current EPA protocol and policy developments for PCB destruction were found to be appropriate for the preparation of a candidate facility test plan and an example public notice.

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Tallow	Stationary Sources	06A
Chlorine Aromatic Compounds	Polychlorinated Biphenyls	07C
Biphenyl		
Boilers	Yellow Grease	13A
Waste Disposal	Rendering Plants	

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1. BACKGROUND INFORMATION

SOURCE OF CONTAMINATED WASTE

A quantity of tallow (yellow grease), produced from the rendering of chicken packing by-products, was contaminated by a transformer leak at a packing plant in Billings, MT. The incident occurred in 1979, and by mid-1979 the contaminated yellow grease had already been sold to distributors who had combined the contaminated material with other stocks. Routine FDA inspections identified the PCB contamination, and subsequent analyses of blended stocks were carried out. The FDA notified the EPA Region X headquarters in September 1979 of the results of those analyses where the PCB content was greater than 50 ppm, and therefore subject to EPA jurisdiction (1).

All grease stocks containing more than 50 ppm of PCB were traced to two tanks at 2900 11th Avenue SW, Seattle, WA; the grease is owned by Seattle Rendering Works, Inc., Seattle, WA. The tanks contain (as of the date of this report) approximately 500,000 lbs and 600,000 lbs, or about 150,000 gallons total (2). FDA inspection of the grease revealed PCB concentrations ranging from 116 to 391 ppm, (3) based on four samples taken from the tanks, and duplicate assays.

DISPOSAL OPTIONS

The contaminated grease, having a PCB content of under 500 ppm, does not require destruction in an EPA-approved incinerator (1). The final ruling governing PCB disposal, 40 CFR Part 761 (1), identifies destruction in high efficiency boilers or disposal in chemical landfills as acceptable alternatives.

"High efficiency" boilers are defined to include power generation boilers and industrial boilers that operate at a high combustion efficiency (99.9%) as defined by the percentage ratio of CO_2 to $CO+CO_2$ concentrations in the combustion gases. These boilers are assumed to be capable of achieving 99.9% or greater PCB destruction efficiency.

There are two approved locations in EPA Region X where PCB contaminated waste may be disposed. These chemical landfills are Chem-Nuclear Systems (Arlington, OR) and Wes-Con (Grand View, ID). It was estimated by Region X that landfilling would cost a waste owner around 8¢/lb (2).

PREREQUISITES FOR HIGH EFFICIENCY BOILER DESTRUCTION (1)

The Regional Administrator may grant approval for PCB Thermal destruction in a boiler if a number of prerequisites are met:

1. The boiler is rated at a minimum of 50 million BTU/hour,

2. The PCB contaminated waste comprises no more than ten percent (10%) of the total of volume of fuel,

3. The waste will not be added to the combustion chamber during boiler start-up or shut-down operations,

4. The combustion emissions will contain at least three percent (3%) excess oxygen and the carbon monoxide concentration will be less than 50 ppm for oil or gas-fired boilers or 100 ppm for coal-fired boilers,

5. The combustion process will be monitored continuously or at least once each hour that the PCB contaminated wastes are being burned to determine the percentage of excess oxygen and the carbon monoxide level in the combustion emissions,

6. The primary fuel and waste feed rates are monitored at least every 15 minutes whenever burning the waste,

7. The carbon monoxide and excess oxygen levels are monitored at least once an hour and if they fall below the levels specified, the flow of wastes to the boiler is stopped immediately, and

8. Records are maintained that include the monitoring data in (5) and (6) above and the quantities of PCB contaminated waste burned each month. When burning PCB wastes, the boiler must operate at a level of output no less than the output at which the reported carbon monoxide and excess oxygen measurements were taken.

CANDIDATE SITES FOR WASTE DESTRUCTION (2)

A survey of potential boiler or incinerator sites by Region X produced the following initial possibilities:

1. The steam boiler at the Seattle Rendering Works plant, located at 5795 S. 130th Place, Seattle, WA;

2. The utility boilers at Puget Sound Power & Light's Shuffleton Plant, located at 1101 Lake Washington Blvd., Renton, WA;

3. A kiln at Ideal Cement Co., in Seattle, WA;

4. A utility boiler at the Pacific Power & Light Centralia (WA) plant.

Sites (3) and (4) subsequently dropped out of consideration, leaving the Seattle Rendering and Puget Power boilers as candidates.

SCOPE OF WORK REPORTED

EPA Region X requested support in evaluating candidate boiler facilities from IERL-RTP. The required support was provided by TRW under Contract No. 68-02-3174.

The scope of work included an evaluation report for each facility, including general background information, description of boiler and operating procedures, and recommendations for modifications required to meet regulatory requirements and good engineering practice. The scope also included a Test Plan for the evaluation of PCB destruction efficiency, and the preparation of an example public notice of intent to conduct verification testing.

2. SEATTLE RENDERING WORKS ANALYSIS

FACILITY BACKGROUND

The Seattle Rendering Works, Inc., facility is located at 5795 S. 130th Place, Seattle, WA, adjacent to the Duwamish River and the Foster Golf Course. The plant location is indicated on the topographic map, Figure 1. The vicinity of the plant is mixed industrial-commercial-residential. The nearest residential areas are immediately west of the plant (about 100 meters), and about 400 meters north, on a bluff approximately 50 meters high.

The plant produces by-products from edible rendering operations, including tallow (or yellow grease). It operates three shifts. Seattle Rendering is also in the business of distribution of bulk sales of grease, through purchases of smaller batches from other rendering plants. The manager in charge is Mr. Wes Benefiel, President.

PLANT OPERATIONS

The boiler at Seattle Rendering is a dual-fuel (gas and/or #6 oil) water-tube Cleaver-Brooks model (Delta D-60) with a design capacity of 35,000 lbs steam/hr. The oil burner is a low-pressure, air atomizing type. The rated gas-fuel efficiency is 78%, so the design heat input is 46,000,000 Btu/Hour. The furnace volume is 755 cu.ft. in the immediate combustion zone, excluding the upper radiant section. Typical stack temperatures at maximum firing are 550-560°F. The combustion zone temperatures are in excess of 2200°F at the back wall. A steam-heated preheater is capable of raising incoming oil temperatures up to 100-240°F. The oil feed pressure is maintained by a gear pump, which is protected by a duplex 30-mesh strainer on the suction side (4).

The boiler has the standard set of safety controls, including a programmed burner shut-down in the event of flame failure; low water conditions; low fuel oil temperature; low fuel oil pressure; low atomizing air pressure; or excess steam pressure. Under normal operation, the oil metering valve and the secondary air flow butterfly are regulated by a modulating motor driving both linkages (5).

The boiler operates at full modulation from a low fire to high fire position, regulated by steam pressure, which is directly affected by steam demand. Since a PCB destruction program would be required to operate at a

Figure 1. Seattle Rendering Works location

steady rate of waste fuel consumption, there would be a change from normal boiler operating practice. If the fuel waste were consumed at maximum fuel feed rates, then some of the generated steam would have to be dumped when process demands dropped off. In the case of waste fuel consumption at some intermediate rate, auxiliary heating must be made up by firing natural gas simultaneously during high demand periods, and excess steam would have to be dumped at low demand conditions.

Facilities for storage of yellow grease at Seattle Rendering include two 270,000 lb capacity heated storage tanks. The grease is pumpable at about 100°F, and congeals at lower temperatures. Other storage and transport equipment includes two 50,000 lb insulated trailers, and one 20,000 lb insulated trailer. Very large heated storage tanks are rented at terminal facilities, such as at Harbor Island (6).

The processing operations are not expected to be hindered by the proposed PCB waste incineration. Presently there is a spare storage tank at the site, and one of the large insulated trailers (and the smaller one also) can be made available.

RECOMMENDATIONS ON THE FEASIBILITY OF USING THE SEATTLE RENDERING BOILER

Suitability of Yellow Grease as Boiler Fuel (7)

The inspection of a grease sample from one of the contaminated shipments (Fujitsuki Maru #1, port tank 09-15-79) produced the results, shown in Table 2-1; two grades of fuel oil are shown by comparison. These inspection results provide some confidence that the grease could be burned undiluted, since:

- The viscosity is between that of #5 and #6 fuel oil, so atomization should be good with a burner that is usually run with #6 oil.
- The fuel value of the grease is 93% of a #6 oil value.
- The ash content is low.

Furthermore, a telephone report obtained from Mr. Keith Markegard at Pierce Packing* confirmed that they had burned 600,000 lbs of grease in their steam boiler, with good combustion characteristics.

*Billings, MT.

TABLE 2.1 LABORATORY INSPECTIONS

	Grease	#5 Fuel Oil	#6 Fuel Oil
Viscosity			
SUS @ 122°F	143.7	40	300
SUS @ 200°F	59.8	-	-
Density, lbs/gal			
@ 122°F	7.459	@ 60°, 8.0	@ 60°, 8.33
@ 180°F	7.266	-	-
Btu/lb	16,779	18,250	18,000
Moisture %	0.41	0.05	0.05
Water & Sediment %	2.8	1	2
Carbon %	76.6	87.5	88.3
Hydrogen %	11.9	10.2	9.5
Oxygen %	10.5	-	-
Sulfur %	0.01	1.1	1.2
Ash %	0.12	-	0.1

Estimated Destruction Efficiency

The residence time of the PCB's in the furnace combustion zone has to be determined as part of the evaluation of destruction efficiency. At a waste feedrate of 6 GPM, the actual volumetric flowrate of combustion gases through the 755 cu.ft. furnace volume is 43,097 ACFM, yielding a residence time of 1.1 seconds. The residence time will be twice as long at a feedrate of 3 GPM, since the gas volumetric rate is half as much.

The estimated destruction efficiencies under these conditions depends on a number of factors, including:

- Comparison of residence time and temperature to those specified in 40 CFR, Part 761, Subpart E: 1200°C (2191°F) @ 2 seconds, or 1600°C (2912°F) @ 1.5 seconds dwell:

  (These conditions are for waste incinerators, burning PCB wastes of any concentration).

- Estimated efficiency of the Cleaver-Brooks burner, and the ease of atomization of the grease fuel, as compared to #6 fuel oil.

- The likelihood of achieving high destruction efficiencies with PCB concentrations of a few hundred ppm, vs. percentage range concentrations found in some other wastes (it's always easier to remove high percentages of high concentrations). 99.9% destruction efficiency is often obtained with high efficiency incinerators and high PCB concentrations.

The likelihood of achieving 99.9 + % PCB destruction is estimated to be very good at a 3 GPM feedrate, since the time and temperature relationships may approximate those of good incinerator practice. It is less certain that a 6 GPM feed rate would yield equivalent destruction efficiency, but the operation at 6 GPM would certainly be preferred for reducing the program length. Therefore, the verification test should determine the destruction efficiency and combustion temperature at both feedrates.

The boiler operation under automatic control will allow full modulation from low fire to high fire, regulated by steam pressure. High fire fuel demand would be about 6 GPM, since the Btu content of grease and #6 oil are similar. Low fire demand is about 25% of high fire, or about 1.5 GPM (4).

Recommended Exceptions to Standard Prerequisites for Boiler Specifications and Operations

Although the Cleaver-Brooks boiler at Seattle Rendering does not meet the standard prerequisite of 50 million Btu/hr heat input (at full output), it comes close at 46 million Btu/hr.

It is recommended that the standard prerequisite of a maximum blend of 10% waste (with the remainder fuel oil) is less appropriate for the Seattle Rendering program than a 100% waste fuel choice. The 10% blend is based on the possibility of using any waste, including those with very low fuel value. As already noted, the Btu content of yellow grease is very close to #5 or #6 fuel oils, and the combustion characteristics are judged to be good. Furthermore, there are no present facilities available for blending of grease and fuel oil.

RECOMMENDATIONS FOR FACILITY MODIFICATIONS REQUIREMENTS

Logistics

Verification Testing: Use 50,000 lb (~6700 gal) trailer, go for 1.5 days, then switch to small (3000 gal) trailer for 0.75 days while large trailer is returned to port for reloading. This assumes that flexible lines can be directly coupled to the oil feed pump for the trailer.

Post Test: Transfer from 50,000 lb trailer to heated 270,000 lb storage tank (9 days storage). The trailer will have to make 6 round trips to get the tank filled. Since turn-around time (gate-to-gate) for a trailer is about 1 hour for loading, (or unloading) and the port-to-plant transit time is about 0.5 hr, 2 loads/day will be easy. Three days of waste fuel can be brought into the plant in one day.

A copy of each loading ticket should be recorded. If the transport of the grease falls into a hazardous waste category, compliance with the necessary state and DOT manifest regulations will be required.

Trailer-to-Tank Transfer

A temporary dike must be set up around the transfer area, sized to retain up to 10% of the storage tank capacity (10% X 4839 cu.ft. = 484 cu.ft.). This can be made up with sandbags and 6 mil polyethylene. Vent control will not be required because of the low volatility of grease and PCB's.

The trailer and transfer hoses should be dedicated during the program. The existing 300 GPM transfer pump can be used, along with existing transfer hoses and quick-disconnect couplings.

Waste Fuel Handling System

This is illustrated schematically in Figure 2. Modification or additional equipment requirements are as follows;

a. Provide booster pump (20 GPM centrifugal, 0.5 HP) prior to existing tank to oil feed pump (Note: existing 300 GPM pump cannot be used as both a loading and feeding pump, since these two requirements will conflict). Disconnect existing oil feed and return lines.

b. Tee from bottom discharge line to booster pump suction: break connection at branch to second storage tank, to insure that no contaminated grease could be run down to second tank. Provide valves on suction and discharge to allow removal for repair if necessary.

c. Install 2 inch line from booster pump discharge to existing oil pump suction---run through back wall of boiler room to minimize run length. Provide 1 inch insulation, and return line to storage tank to maintain high flow velocity to prevent setting up.

d. Install pressure gages upstream of basket strainers at oil pump stand.

Additional measurement points that should be installed for adequate boiler monitoring during PCB incineration include:

- Flowrate indicator and recorder downstream of oil regulating valve.
- Air windbox pressure indicator.

CONDUCT OF THE WASTE INCINERATION

Verification Testing

Background emission levels will be determined by running the PCB emissions testing procedure while the boiler is burning #6 fuel oil at a steady feed rate. A PCB analysis will be required for fuel oil samples.

Normally, three separate tests are conducted at the same conditions for verification of the efficiency of PCB waste incineration. In this program the performance at multiple grease feedrates is needed to decide on recommended operating conditions. Therefore, the verification test plan will be:

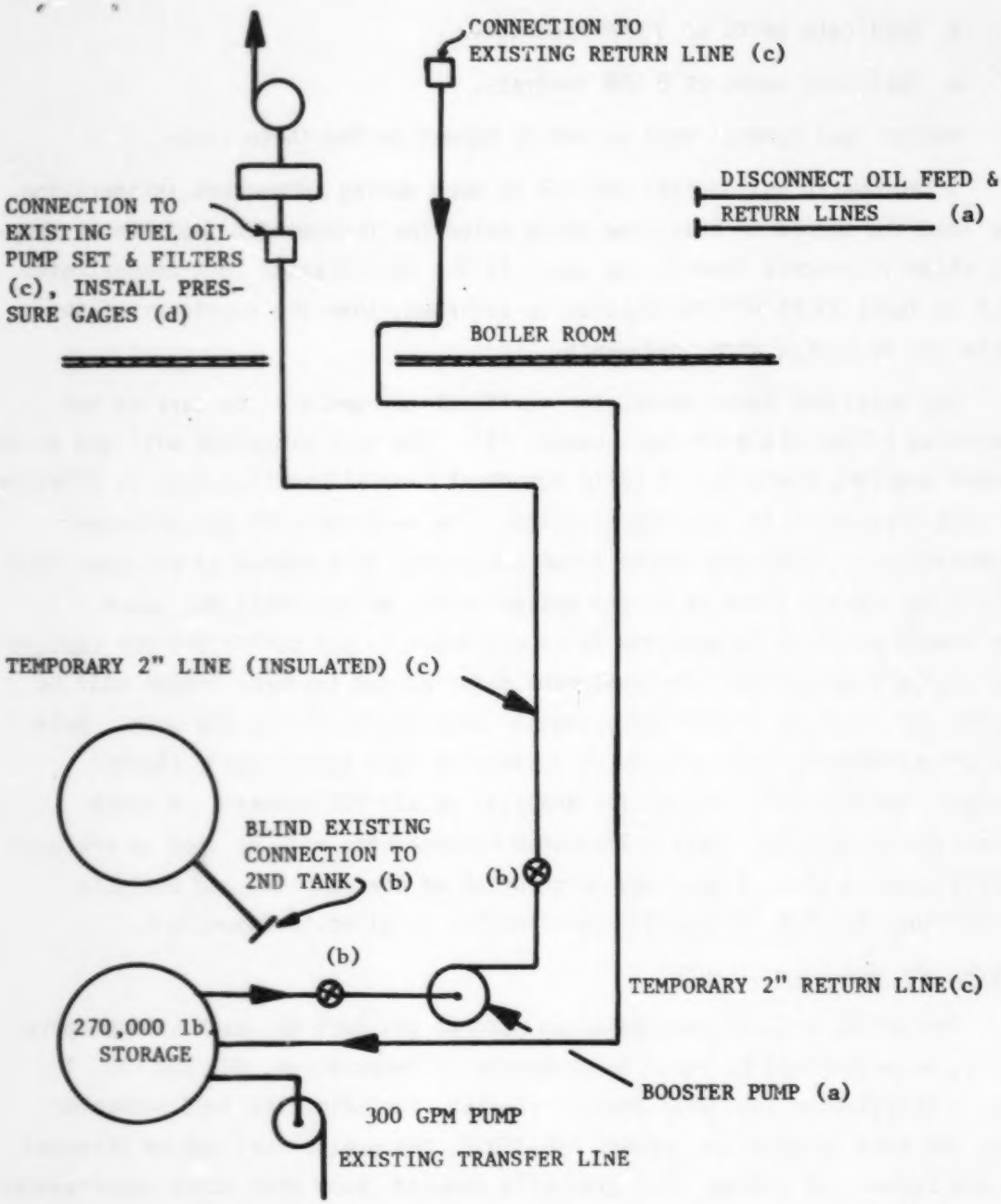

Figure 2. Waste Fuel Handling Schematic.

- Duplicate tests at 3 GPM feedrate.
- Duplicate tests at 6 GPM feedrate.

Boiler fuel control must be set on manual during these tests.

If automatic boiler fuel control is used during subsequent incineration, the feedrate should be kept from going below the recommended feedrate by dumping steam if process demands are low. If the verification test demonstrates that at least 99.9% PCB destruction is achieved, then the remainder of the waste can be burned with confidence.

The emissions tests during the verification burn will be carried out according to the GCA draft test manual (8). The test procedure will use an integrated sampling train with a solid adsorbent (florisil) section that is effective in capturing PCB's in low concentration. The sampling will be conducted isokinetically, with the sample probe positioned at a number of pre-specified points during the traverse of the boiler stack, at two ports 90 apart. The sampling effort is expected to take 3 hours to get sufficient PCB capture for analysis detection. The adsorbent material and impinger rinses will be sealed and taken to a laboratory that is experienced in PCB analysis. Both gas chromatography (GC) and gas chromatograph mass spectrometry (GC/MS) analysis methods will be used for analysis of all PCB isomers. A quick prescreening test for total chlorinated hydrocarbons will be used to evaluate verification tests. A detailed description of the sampling and analysis methodology for PCB destruction verification is given in Appendix B.

Operations and Surveillance

The boiler will be started up on natural gas fuel to reach steady operations, as determined by stack measurements of temperature, CO, and O_2. The grease circulation loop will then be started, including the feed preheater. When the feed temperature reaches 140-150°F, the grease fuel can be directed to the burner and the gas fuel gradually reduced, such that stack temperatures and steam pressure remains constant. The grease fuel should not be heated above 180°F, since it may smoke at any point where it comes into air contact (probably the storage tank).

Surveillance of the boiler and fuel handling areas must be maintained on a 24-hour basis, with the following data to be recorded: CO, O_2, fuel rate.

- Boiler shut-down should be done in a similar manner to start-up, with gas fuel used to finish off the firing before shut-down. The grease should be drained from the fuel line before any shut-down; otherwise it should be kept hot and circulating.

- If a fuel leak is detected in the system that cannot be corrected by a fitting adjustment, then the grease circulating loop must be shut-down and drained prior to repair. The grease already spilled should be allowed to congeal and then be scraped up and returned to the fuel storage tank. Scraping congealed grease into the hatch of an unloading trailer may be possible. Final spill cleanup can be done with a hexane solvent.

- The contaminated waste will be transported in a dedicated trailer, and transfer hoses will also be dedicated to the disposal program. This procedure will avoid the mixing of contaminated grease with non-contaminated grease.

Clean-Up

The following equipment clean-up will be required:

- Trailer
- Transfer hoses
- Transfer pump
- Booster feed pump
- Feed and recycle lines, including fuel oil pump.

The entire transport-and-fuel feed system should be flushed with uncontaminated grease and combustion continued until the grease PCB concentration drops below 50 PPM. The temporary connections can then be removed and the #6 fuel oil feed loop restored.

ENVIRONMENTAL IMPACT

The anticipated impact of PCB waste burning at the Seattle Rendering facility was modeled with a point-source dispersion model, actual stack dimensions, and a range of local meteorological conditions, as reported from the PSAPCA* station at Tuckwila/South Center, about 2 miles south of the plant, (Appendix A.).

*Puget Sound Air Pollution Control Agency

The flat-terrain dispersion model is only useful for impact analysis up to the point of a significant terrain change. The prevailing winds at the source location (35% of the time) are south to southwest, with neutral (Class "D") atmospheric stability.

There is a sharp terrain rise of 50 m. only 400 m. in a prevailing (SSW) direction from the rendering plant source. The calculated effective stack height is 40-65 meters. Model predictions at 400 m. of PCB concentrations at the plume centerline (which is worst-case conditions) are as follows:

Feed Rate	Wind Speed	No PCB Destruction	99.9% PCB Destruction
6 GPM	10 m/sec	6.4 $\mu g/m^3$	6.4 ng/m^3
6 GPM	4 m/sec	16.0 $\mu g/m^3$	16.0 ng/m^3
3 GPM	10 m/sec	1.6 $\mu g/m^3$	1.6 ng/m^3
3 GPM	4 m/sec	4.0 $\mu g/m^3$	4.0 ng/m^3

The modeling estimates are based on calculated emission quantities as follows:

- 6 GPM feedrate using worst case of 400 ppm PCB's: 9110 SCFM stack discharge, 0.12 gm/sec uncontrolled, 0.12 mg/sec controlled emission rates.
- 3 GPM feedrate, using moderate case of 175 ppm PCB's 4555 SCFM stack discharge, 0.03 gm/sec uncontrolled, 0.03 mg/sec controlled emission rates.

The ground-level concentration of the plume under flat-terrain assumptions may be more realistic at 1.5 to 2 km downwind, after the plume has passed over the bluff. The atmospheric PCB concentrations for a 99.9% efficient destruction operation are in the range of 0.1 to 0.4 ng/m^3.

Techniques for ambient monitoring of these extremely low PCB concentrations are still being developed, but it is recommended that an attempt be made to make such a measurement at the most likely downwind position, in support of the verification test. The ambient monitoring methodology is described in Appendix B.

An analysis of downwash concentrations of PCB's was also done, using the building as an area source. In a downwash model, dispersal of pollutants occurs in the immediate, ground level vicinity of a source, rather than through an elevated plume. Calculated atmospheric concentrations of PCB's were estimated to be around 0.2 ng/m^3 with 99.9% destruction. The OSHA limit for worker exposure to PCB's on an 8-hour day, 40-hour week basis is 1 mg/m^3 with 42 percent PCB chlorine content, so that the downwash concentration certainly does not threaten worker safety.

3. SHUFFLETON POWER PLANT ANALYSIS

FACILITY BACKGROUND

The Shuffleton Power Plant, owned by the Puget Sound Power and Light Co.(PSPL), is located at 1101 Lake Washington Blvd., Renton, WA. The plant is on the southern edge of Lake Washington, as indicated on the topographic map, Figure 3. The vicinity is generally industrial and recreational. The nearest residential areas are about 1 km east of the plant.

Shuffleton is operated at a steady level of 330,000 lb/hr of steam in each of three oil-fired boilers. The plant was constructed in 1929, and is expensive to operate. Consequently, Shuffleton is only run when the anticipated load demand in the PSPL service area cannot be met by other generating sources (9). The plant superintendent is Mr. Bill Clark.

PLANT OPERATIONS

The Shuffleton boilers are balanced draft type (FD, ID fans); there are 16 Peabody mechanical burners in each boiler, burning #6 fuel oil heated to 200°F.

The available measurements include air/fuel ratio, oil pressure, windbox pressure, furnace draft, fuel oil temperature, air preheater temperature and pressure, and oxygen in the stack gases. Fuel oil is not presently metered, although an orifice exists in the fuel oil line.

The fuel oil is supplied from large storage tanks to two smaller service tanks, each having a working capacity of 800 bbls. The tanks are run alternately, on about a 5-hour cycle, while 3600 to 3900 bbl per day of fuel oil are consumed. The tanks have open hatches at the top which could be used for pumping in other fuels to get a mixed fuel. The fuel is kept at 150°F in the service tanks. The fuel oil is pumped out of the service tanks by three 80 GPM pumps, and distributed through heat exchangers to raise the fuel temperature to 200°F. The fuel is then injected into each of the burners in the three boilers. The viscosity of #6 oil is sufficiently lowered by the 200°F preheat to get good burner and combustion performance (9).

The operations of the Shuffleton power plant are not expected to be hindered by the proposed PCB waste incineration, as indicated by the follow-

Figure 3. Shuffleton (Puget Power) Plant location

ing discussion on feasibility. Three-shift operations coverage of the boiler and fuel handling system will provide the necessary surveillance of combustion performance that is needed for PCB incineration. There is reason to believe that close surveillance is mandatory for maintaining good combustion at Shuffleton. The plant has received frequent citations for opacity violations (10), despite a test of the No. 1 boiler which showed particulate emissions within compliance (11). A combustion consultant's report submitted to Puget Power identified possible causes of poor combustion to include inadequate fuel atomization (due to low fuel oil temperature) and dirty burners (12).

RECOMMENDATIONS ON THE FEASIBILITY OF USING THE SHUFFLETON BOILERS FOR PCB WASTE INCINERATION

Suitability of Yellow Grease as a Boiler Fuel

The first consideration for suitability is the determination of miscibility, or degree of mixing, of grease and #6 fuel oil, since using a blended fuel is the technically simplest method for waste incineration in a large boiler. Yellow grease and #6 fuel oil mixing tests were conducted by Northwest Laboratories at two blend ratios (10% and 30% grease, by volume) and two temperatures (180°F and 200°F). The results of these four tests were consistent; the blends were miscible, with no stratification, at all conditions (13).

The inspection of a grease sample from one of the contaminated batches by Northwest Laboratories produced the results reported in Table 2-1; two grades of fuel oil are shown by comparison.

The previous inspection results provide further confidence that the grease will combust well with #6 fuel oil, since:

- The viscosity is between that of #5 and #6 fuel oil, so burner atomization with the blended fuel should be good.
- The fuel value of the grease is 93% of a #6 oil value.
- The ash content is low.

Estimated Destruction Efficiency

The residence time of the PCB's in the boiler combustion zone is a consideration in the evaluation of destruction efficiency. At a typical fuel

feed rate of 38 GPM, and 4-5% excess oxygen, the calculated rate of combustion gas flow is 1111 std. cu ft/sec (14). The estimated residence time in the lower half of the boiler is 2.5 seconds, with another 2.5 seconds dwell in the upper zone (15). The temperature in the combustion zone in the vicinity of the burners, has been measured at 2800°F (16).

The estimated destruction efficiencies under these conditions depends on a number of factors, including:

- Comparison of residence time and temperature to those specified in 40 CFR, Part 761, Subpart E: 1200°C (2192°F) @ 2 seconds, or 1600°C (2912°F) @ 1.5 seconds dwell:

  (These conditions are for waste incinerators, burning PCB wastes of any concentration).

- Efficiency of the burners and the ease of atomization of the grease and #6 fuel oil blend.

- The likelihood of achieving high destruction efficiencies with blended PCB concentrations of less than a hundred ppm, vs. percentage range concentrations found in some other wastes (it's always easier to remove high percentages of high concentrations). 99.99% destruction efficiency is often obtained with high efficiency incinerators and high PCB concentrations.

The likelihood of achieving 99.9% PCB destruction is estimated to be good, given the similarity of the boiler conditions to good incinerator practice, and the compatibility of the grease and #6 fuel oil.

Recommended Exceptions to Standard Prerequisites for Boiler Operations

It is recommended that the PCB incineration be conducted with a grease-to-fuel oil ratio of 30/70 instead of the standard prerequisite ratio of 10/90. There are good arguments for using a 30% blend, since the length of time needed to complete the effort will be shortened by a proportionate amount, and the grease is not expected to cause any combustion problems or available heat reductions. The environmental consequences of burning a 30% blend, and the logistical limitations of supporting a higher grease percentage, are discussed below.

RECOMMENDATIONS FOR FACILITY MODIFICATIONS

Logistics

The two alternating service tanks (800 bbl working capacity) will be used for temporary storage of the grease (as a blend), and for making up a blend in the off-line tank; this should be done while the tank is filling with #6 oil, to get the benefit of agitation during the fill.

If a 10% blend is made up, it would require 3200-3400 gallons of grease to be added to the service tank, and one trailer (6500 gal. capacity) for support. The single trailer could probably split a load between two alternate tank fillings, and then return to the port. The plant-to-port round trip, with filling, is estimated to take 3 to 4 hours. This turnaround time will not be limiting, given a 5-hour cycle time with the tanks.

If a 30% blend is made up (as recommended), it would require 9600-10,200 gallons of grease addition per tank, and two trailers for support. They would both be required to return for reloading following each tank filling. Blends much greater than 30% would cause a logistical limitation.

Trailer-to-Tank Transfer

The rundown line between two large storage tanks and the service tanks has a connection that could be used for transfer, but top-filling of the service tanks is preferred for the agitation benefit. The transfer area must have a temporary dike set up, sized to retain a trailer load (under 1000 cu.ft.) using sandbags and polyethylene sheet.

The transfer pump and temporary power connections must be provided, along with transfer hoses. The transfer pump should have about a 200 GPM capacity, to prevent any unnecessary hold-up time for trailers.

CONDUCT OF THE WASTE INCINERATION

Verification Testing

Background emission levels will be determined by running the PCB emissions testing procedures while the boilers are burning uncontaminated #6 fuel oil. A PCB analysis will also be done on fuel oil samples.

The schedule will include emissions testing on three sequential days of operation, to determine what day-to-day differences may occur. This series of tests will be done with one batch of blended grease and fuel oil each day, so that PCB's will not be burned unless emission testing is in progress. Continuous oxygen and carbon monoxide monitoring of stack gases will also be done during the verification test sequence. If the verification test demonstrates that at least 99.9% PCB destruction is achieved, then the remainder of the waste can be burned with confidence.

The emissions tests during the verification burn will be carried out according to the GCA draft test manual (8). The test procedure will use an integrated sampling train with a solid adsorbent (florisil) section that is effective in capturing PCB's in low concentrations. The sampling will be conducted isokinetically, with the sample probe positioned at a number of prespecified points during the traverse of the boiler stack. Since equal amounts of fuel are supplied to each of the three identical boilers, then it is sufficient to sample one stack rather than all three. The sampling effort is expected to take 3 hours to get sufficient PCB capture for analysis detection. The adsorbent material and impinger rinsed will be sealed and taken to a laboratory that is experienced in PCB analysis. Both gas Chromatography (GC) and gas chromatograph-mass spectrometry (GC/MS) analysis methods will be used for analysis of all PCB isomer. A quick prescreening test for total chlorinated hydrocarbons will be used to evaluate verification tests. A detailed description of the sampling and analysis mehtodology for PCB destruction verification is given in Appendix B.

Operations and Surveillance

The grease should not be pumped into the fuel oil service tank until it has been established that the boiler is operating satisfactorily, as evidenced by the combustion parameters holding at the criteria specified by regulation 40 CFR 761, and visual inspection of the burner flame. After the blended fuel firing is initiated, a reinspection of the combustion parameters will be required.

Surveillance of the boiler and fuel handling areas must be maintained on a 24-hour basis, with the following data to be recorded: CO, O_2, fuel rate. Periodic measurements of CO_2 will also be done.

Clean-Up

The following equipment clean-up will be required:

- One to two trailers
- Transfer hoses
- Transfer pump

If any spill or leak occurs during trailer unloading, the equipment used to scrape up the congealed grease will also require cleaning. A hexane solvent can be used for cleaning, and added to the fuel oil in small quantities. The blended grease and fuel oil will probably not be considered a contaminant in the fuel oil handling system, since the PCB content will be well below 50 ppm. The system will be purged by the routine use of uncontaminated fuel oil.

ENVIRONMENTAL IMPACT

The anticipated impact of PCB waste burning at Shuffleton power plant was modeled with the EPA "Valley" model, which takes into account a certain amount of terrain variation. The computer program was run by the PSPL quality staff, using terrain and stack dimension parameters already set up for the Shuffleton plant and vicinity.

The model was run with a low wind speed of 2.5 m/sec and a prevailing southwest wind, over a range of atmospheric stability conditions. Local wind speed and direction data are given in Appendix A. The most stable conditions ("F" stability) usually yield the highest ground concentrations of a pollutant, since dispersion by air mixing is minimal. The following normalized data factors were computed for stability Classes A thru F (A being the most unstable). The data factors are multiplied by an estimated emission rate to get a maximum 1-hour concentration at the indicated downwind distance.

	Stability Class					
	F	E	D	C	B	A
Data Factor →	3.95	2.11	0.027	0.129	0.245	0.20
Location of maximum 1 Hr PCB concentration @ groundlevel	2 km NE	2 km NE	12 km NE	4 km NE	2 km NE	near plant

The maximum 1-hr PCB concentration can then be estimated, using "F" stability conditions, from the emission rates determined as follows:

a. 10% blend, 3200 gal. of 400 ppm (worst case) grease burned over 5-hour period yield 0.24 g/sec (no control), or 0.24 mg/sec (99.9% controlled) emission rate;

   Worst case model prediction for downwind PCB concentration = 3.95 X 0.24

   = 0.9 $\mu g/m^3$ (no control), or 0.9 ng/m^3 (99.9% control) at 2 km NE of plant.

b. 30% blend yields three times the emission rate above---0.71 g/sec (no control), or 0.71 mg/sec (99.9% control).

   Estimated downwind PCB concentration at 2 km NE then will be: 2.7 $\mu g/m^3$ (no control), or 2.7 ng/m^3 (99.9% control).

These estimates can be compared to the OSHA exposure limit for PCB's. The OSHA allowable concentration for worker exposure on an 8-hour day, 40-hour week basis is 1 mg/m^3 with 42 percent chlorine content in the PCB's.

Techniques for ambient monitoring of these extremely low PCB concentrations are still being developed, but it is recommended that an attempt be made to make such a measurement at the most likely downwind position, in support of the verification test. The recommended methodology is described in Appendix B.

REFERENCES

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6. W. Benefiel, personal communication.

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8. Test Plan for Evaluation of PCB Destruction Efficiency in Industrial Boilers, GCA June 1979.

9. Personal communication, W. A. Wood, Assistant Superintendent, Puget Sound Power & Light Company.

10. Puget Sound Air Pollution Control Agency, inspection reports.

11. Atmospheric Emission Evaluation, Alsid, Snowden & Associates report to PSP&L Company, February 1979.

12. Boiler Combustion Efficiency, Shuffleton Power Plant, Puget Sound Power & Light Company, Weiland, Lindgren and Associates, March 1979.

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14. Air Pollution Engineering Manual, AP-40, U.S. Environmental Protection Agency.

15. PSP&L Company Drawing RB430, Boiler cross section, Shuffleton Power Plant.

16. Personal communication, T. Van Decar, PSP&L Company.

APPENDIX A
LOCAL METEOROLOGICAL DATA

1. Local wind speed (1/80)

2. Local wind direction (1/80)

3. Location of met station (#17)

Table A1 Local Wind Speed (1/80)

STATION: TUKWILA, SOUTH CENTER ***AMBIENT AIR QUALITY DATA REPORT*** DATA REPORT # AQ90W461-1 PAGE: 20

AGENCY: PUGET SOUND AIR POLL.CONT AUTH STATE: WASHINGTON SITE: 1782-K50 YEAR: 1979 MONTH: JANUARY

POLLUTANT: WIND SP RESULTANT UNITS: MPH DATA-FORMAT: XXX.X POLL CODE: 61103 METHOD: 20

1HR AVE SHOWN UNDER ENDING HR PROJECT: 01 CONV FACTOR: NONE USED RUN-DATE 05/07/79

HOURS PST

DA	D	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MAX	MN
01	M	1.4	2.2	2.0	0.6	3.6	2.1	4.1	2.2	3.5	4.9	2.4	3.8	2.8	3.1	7.7	3.8	5.5	7.0	7.8	4.3	1.0	2.9	3.3	2.2	7.8	3.5
02	T	0.2	2.2	1.6	1.8	2.0	3.0	2.9	4.6	3.7	3.7	4.6	3.9	5.4	2.2	2.3	4.0	2.8	3.5	1.2	2.1	2.1	2.9	3.0	1.3	5.4	2.8
03	W	1.0	2.8	2.6	2.5	2.9	3.0	3.7	2.5	1.7	4.9	3.6	5.6	5.3	6.7	7.6	5.9	8.5	7.0	6.3	5.5	4.3	2.4	2.8	2.5	8.5	4.2
04	T	1.7	1.6	3.6	5.1	2.1	2.8	6.8	1.7	10.1	10.9	13.8	14.5	9.6	10.4	8.9	6.9	8.6	8.7	10.1	9.0	5.6	1.6	3.3	3.3	14.5	6.7
05	F	9.9	14.4	10.8	7.1	3.9	3.9	4.5	6.4	6.8	9.1	6.6	9.7	11.3	12.3	12.4	12.3	11.0	6.6	8.4	8.7	7.5	5.5	3.9	4.5	14.4	8.2
06	S	4.8	5.1	6.0	3.6	4.9	5.5	8.2	5.1	6.9	8.3	9.2	8.6	7.7	5.8	5.3	1.6	9.4	7.3	2.4	0.9	1.4	2.5	2.9	0.7	9.4	5.2
07	S	2.8	2.5	1.5	1.6	2.0	0.9	1.6	2.4	2.6	1.2	0.8	7.6	4.5	9.1	10.2	1.6	1.0	0.8	1.0	0.3	2.2	3.1	3.1	1.0	10.2	2.7
08	M	2.8	3.9	2.4	0.5	0.2	0.7	0.7	0.0	0.6	2.2	6.8	3.2	8.4	4.7	8.2	4.4	2.3	1.5	5.1	4.8	0.9	2.5	2.4	0.6	8.4	2.9
09	T	0.2	0.0	0.0	0.1	0.1	0.2	1.4	4.7	5.3	1.3	2.1	1.6	1.5	3.0	3.5	0.9	3.8	3.8	3.5	2.4	5.3	3.2	4.1	3.6	5.3	2.3
10	W	5.3	4.1	3.9	3.8	1.8	4.9	4.5	2.0	0.6	1.8		1.3	0.0	0.2	1.7	2.8	2.6	2.5	3.0	1.8	0.0	0.1	0.9	0.2	5.3	2.2
11	T	0.8	0.3	0.8	1.2	4.3	6.1	3.5	1.8	3.0	4.0	2.4	0.3	3.3	0.0	0.3	1.2	2.5	3.7	3.3	2.0	1.2	1.5	4.3	3.9	6.1	2.3
12	F	4.0	5.1	4.4	4.3	5.4	3.5	4.8	6.4	7.0	8.9	6.3	8.1	9.0	6.0	8.9	8.4	7.1	8.9	7.5	8.7	9.1	6.1	5.8	5.9	9.1	6.7
13	S	4.4	2.4	4.0	1.0	0.0	0.3	0.1	0.0	0.1	0.3	0.2	2.2	6.9	6.8	7.4	7.8	8.2	7.3	7.6	7.0	2.9	5.6	4.5	5.4	8.2	3.9
14	S	7.1	5.1	4.8	5.2	8.2	7.5	4.4	4.8	9.0	7.0	1.4	5.1	1.4	3.3	4.6	3.5	3.5	2.6	2.1	1.7	2.8	0.0	0.1	0.6	9.0	4.0
15	M	0.5	0.0	1.3	0.7	0.0	1.7	0.0	0.6	0.6	0.7	0.8	2.2	1.5	2.5	3.2	2.2	3.0	2.1	0.9	1.2	0.0	1.3	1.3	0.5	3.2	1.2
16	T	0.8	2.0	1.8	1.3	0.5	0.6	0.8	0.6	0.7	0.0	0.5	2.2	0.2	0.6	0.1	0.9	0.1	0.0	0.2	0.0	1.0	0.2	1.4	0.5	2.2	0.7
17	W	1.0	0.5	0.7	0.1	0.1	0.1	0.9	1.7	1.5	0.9	1.5	2.1	4.1	5.1	4.9	4.4	5.1	4.9	6.0	2.9	2.6	3.0	1.0	3.1	6.0	2.4
18	T	2.4	0.6	0.5	2.0	1.7	0.7	2.6	1.6	2.5	2.9	3.1	3.8	5.4	3.3	6.1	5.2	6.6	5.6	5.9	6.1	5.4	4.9	3.5	1.7	6.6	3.5
19	F	3.9	2.0	3.0	3.1	4.1	7.5	4.5	1.7	0.6	0.8	3.5	6.3	1.5	4.6	5.1	3.3	1.5	1.6	0.8	0.0	0.5	1.4	1.8	3.5	7.5	2.8
20	S	3.2	4.5	4.3	4.6	4.4	2.6	3.7	4.4	6.9	12.7	14.2	11.3	10.4	13.9	10.0	9.0	7.1	6.2	5.2	2.3	2.9	3.0	4.1	5.9	14.2	6.5
21	S	6.6	8.3	5.5	1.7	2.0	3.6	2.3	2.0	0.6	2.1	1.6	0.7	3.7	5.6	4.4	1.3	3.7	1.7	0.6	0.0	1.3	2.5	2.3	0.6	8.3	2.7
22	M	2.9	0.2	0.9	0.5	1.0	1.7	1.2	0.8	1.3	3.3	2.8	3.0	2.4	1.7	2.0	1.8	0.8	0.5	1.6	2.8	2.5	1.5	0.8	1.7	3.3	1.7
23	T	0.9	1.4	0.0	0.0	0.5	0.3	0.5	2.1	2.6	3.3	4.5	3.8	2.4	5.2	6.0	5.5	5.1	3.5	1.8	3.1	2.6	1.4	1.5	2.6	6.0	2.5
24	W	0.7	0.9	0.2	0.2	0.3	1.5	0.0	0.1	1.2	1.4	3.8	5.2	4.5	6.7	6.8	8.5	8.5	5.8	4.8	3.3	0.6	0.2	0.1	0.0	8.5	2.7
25	T	0.0	0.0	0.1	1.2	1.5	0.6	0.2	0.0	0.6		1.4	6.6	6.0	5.2	5.6	4.5	3.6	1.0	0.5	0.5	0.0	0.8	2.0	1.6	6.6	1.9
26	F	2.2	2.8	1.3	2.9	3.1	2.4	3.8	3.8	4.1		5.1	2.9	5.1	7.3	2.8	3.0	0.7	6.0	8.4	5.4	7.7	7.7	7.8	7.1	8.4	4.5
27	S	6.6	2.3	2.0	3.5	2.4	0.7	0.3	0.6	0.5	0.8	2.5	2.6	4.1	3.1	7.4	4.0	3.0	3.6	5.2	5.4	0.5	1.7	3.6	2.6	7.4	2.9
28	S	3.3	3.0	1.6	0.2	0.2	0.5	0.8	0.3	0.2	0.2	0.6	0.6	1.7	6.8	3.6	3.9	2.3	0.6	0.1	0.0	0.0	0.0	0.0	0.0	6.8	1.3
29	M	0.3	0.5	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.3	1.3	4.1	8.5	7.6	4.8	0.9	1.3	0.8	2.6	1.3	1.3	8.5	1.5
30	T	1.3	0.9	1.5	1.4	2.6	2.4	3.2	1.8	1.2	0.6	2.9	7.1	2.6	3.2	1.8	4.1	4.9	2.6	3.2	0.5	1.2	0.9	1.7	1.4	7.1	2.3
31	W	0.0	3.0	1.5	2.5	2.8	1.7	2.2	2.8	2.1	3.5	4.0	5.3					7.9	6.2	3.9	4.1	0.9	1.5	1.8	1.3	7.9	3.0
NO		31	31	31	31	31	31	31	31	31	29	30	31	30	30	30	30	31	31	31	31	31	31	31	31		
MN		2.7	2.7	2.4	2.1	2.2	2.4	2.5	2.2	2.9	3.5	3.8	4.6	4.4	5.0	5.4	4.5	4.8	4.1	3.8	3.2	2.5	2.4	2.6	2.3		3.3
MX		9.9	14.4	10.8	7.1	8.2	7.5	8.2	6.4	10.1	12.7	14.2	14.5	11.3	13.9	12.4	12.3	11.0	8.9	10.1	9.0	9.1	7.7	7.8	7.1	14.5	

TOTAL NUMBER OF HOURLY AVERAGES: 737

# INDICATES < 18 HOURS AVAILABLE FOR DAILY AVERAGE

Table A2 Local Wind Direction (1/80)

STATION: TUKWILA, SOUTH CENTER ***AMBIENT AIR QUALITY DATA REPORT*** DATA REPORT # AQ90R461-1 PAGE: 21

AGENCY: PUGET SOUND AIR POLL.CONT AUTH STATE: WASHINGTON SITE: 1782-K50 YEAR: 1979 MONTH: JANUARY

POLLUTANT: WIND DR RESULTANT UNITS: DEGREES DATA-FORMAT: XXXX. POLL CODE: 61104 METHOD: 20

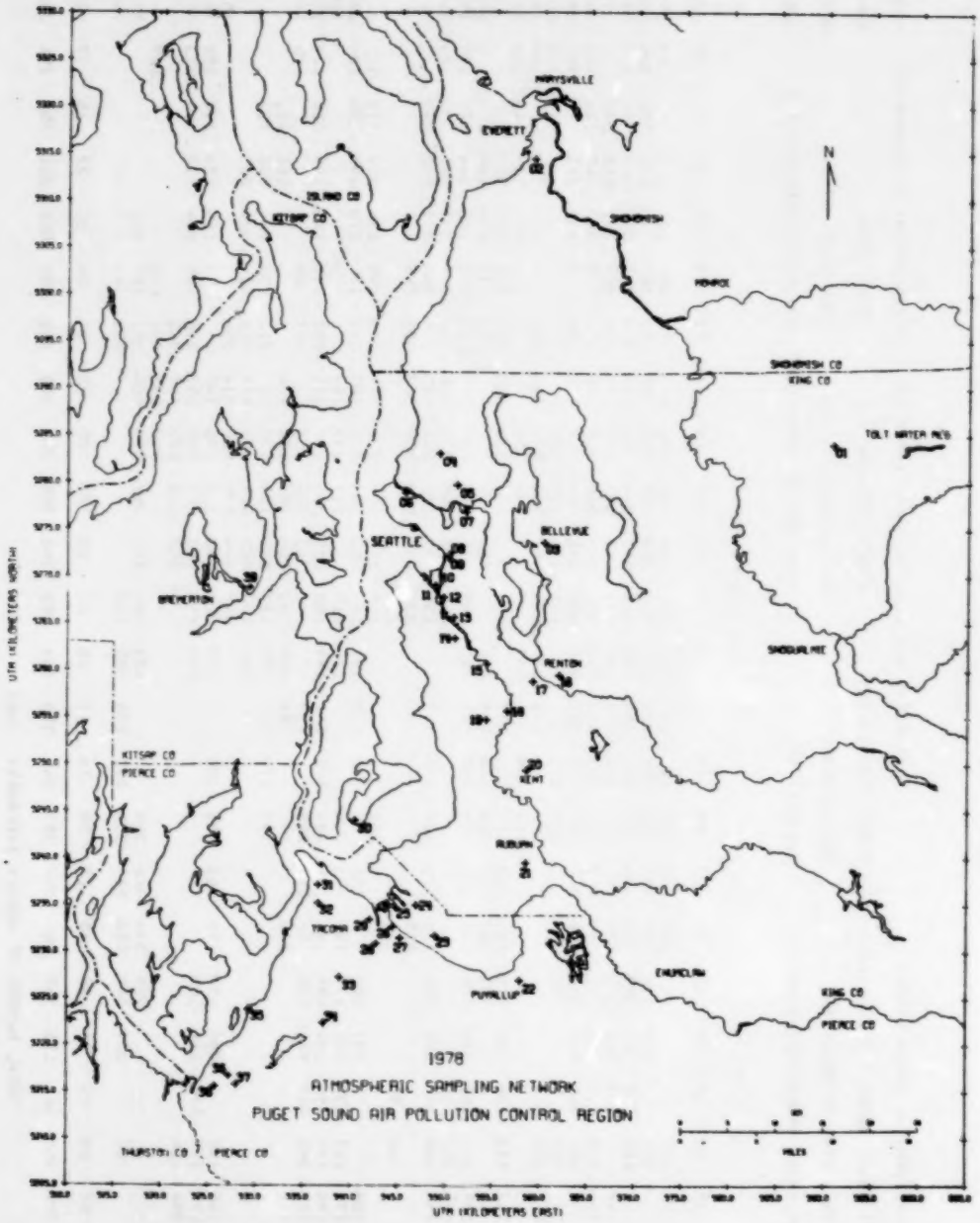
1HR AVE SHOWN UNDER ENDING HR PROJECT: 01 CONV FACTOR: NONE USED NOTE: 000 DENOTES CALM RUN-DATE 05/07/79

HOURS PST

DA	D	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	MAX
01	M		085	004		057	068	075	061	067	100	102	121	118	100	071	049	076	096	101	103		118	090	104	121
02	T		109		053	034	320	358	338	328	008	017	026	348	337	343	348	352	360		001	358	024	358		360
03	W		008	317	348	357	349	356	025	002	353	343	012	011	344	352	003	360	360	353	3[illegible]	344	327	320	327	360
04	T	342		343	355	343	039	089	077	080	078	086	091	093	097	090	094	088	095	080	[illegible]60	047		105	112	355
05	F	094	092	095	100	101	360	042	349	326	329	348	336	349	348	346	346	353	349	349	347	342	348	344	358	360
06	S	355	351	346	029	357	346	352	357	345	351	340	352	341	343	354	042	086	092	235	065		351	298		357
07	S	031	320			290			129	201			081	110	124	105						219	116	097		320
08	M	152	206	204							143	091	093	082	040	073	058	052		103	126		165	142		206
09	T								185	208		337			331	359		162	179	173	137	145	198	181	147	359
10	W	143	113	100	160	216	185	138	085		185					349	333	326	331	339	321					349
11	T					351	357	064	026	028	036	030		007				214	213	194	189			199	195	357
12	F	180	182	181	193	174	192	180	176	182	181	200	185	170	196	229	214	210	202	182	186	170	199	195	192	229
13	S	183	191	197									348	350	355	337	346	352	354	348	341	330	323	330	029	355
14	S	058	360	045	057	081	101	116	126	138	147		133		126	126	088	06[illegible]	344	011	032	342				360
15	M						015						337		003	339	337	335	249							339
16	T		184	198									205													205
17	W								320				156	117	108	132	110	103	096	059	010	010	335		188	335
18	T	169			197	200		166		200	179	172	183	209	191	175	187	192	171	179	195	186	204	205	226	226
19	F	221	247	194	174	177	197	203	095			220	215		217	237	198							206	205	247
20	S	196	190	194	180	199	191	184	199	182	168	180	198	215	216	216	211	207	181	173	186	312	329	337	355	355
21	S	359	004	019	044	175	198	197	205		208			360	036	068		201	204				175	164		360
22	M	172					203				196	200	183	166	157	174	204				180	211			200	211
23	T								193	174	181	194	172	199	187	178	183	212	232	084	090	152			176	232
24	W											013	003	023	024	006	024	028	024	020	003					028
25	T												010	014	038	018	034	058						198		198
26	F	190	185		206	192	198	205	195	199		152	221	163	155	190	142		177	184	174	176	180	182	176	221
27	S	174	187	175	176	180						246	248	243	283	345	352	004	025	024	017		013	049	349	352
28	S	356	354											042	022	023	360	360								360
29	M															049	085	091	086				127			127
30	T					355	334	340	348			085	084	014	352	018	005	351	107	094				079		355
31	W		101		339	342	002	001	354	001	028	025	012					351	348	011	037			150		354
NO		17	19	15	15	19	18	17	20	16	17	20	25	23	26	28	25	26	24	21	22	15	17	21	16	
MX		359	360	346	355	357	360	358	357	345	353	348	352	360	355	359	360	360	360	353	351	358	351	358	358	360

TOTAL NUMBER OF HOURLY AVERAGES: 482

Figure A1 Location of Met Station (#17)



APPENDIX B. EXAMPLE TEST PLAN FOR EVALUATION OF PCB DESTRUCTION EFFICIENCY

STACK SAMPLING

Sampling Methods

The sampling train to be used for PCBs will be a modified Method 5 train as described in "A Preliminary Procedure for Measuring the PCB Emissions from Stationary Sources": W. J. Mitchell, U.S. EPA, August 26, 1976. A solid adsorbent tube containing 7.5 grams of pre-extracted 30/60 mesh Florisil is placed between the third and fourth impingers. Alternative adsorbants are XAD-2 and Tenax GC.

The sampling and velocity traverse will be along two diameters of the stack for a nominal 40 inch diameter stack, a total of 44 points will be sampled to provide a representative sample of the flue gas composition. Total sampling time at a flow rate of approximately 1.0 ft^3/min. should be long enough to yield approximately 10 µg of PCBs, based on a destruction efficiency of 99.9 percent.

Sampling will be isokinetic (±10 percent) with readings of flue gas parameters recorded at every sampling point during the traverse. In the event that isokinetic sampling cannot be maintained, the train will be shut down and the problem remedied. In the event that either steady operation is not maintained, or monitored gas parameters (CO, CO_2, O_2) are out of the specified limits, the testing will be stopped until conditions are stabilized. Steady operation of the boiler will be the responsibility of operating personnel and the verification burn coordinator.

Test Matrix

A series of PCB emission tests at steady boiler operating conditions will be conducted, such that three separate days of testing are carried out for a single waste fuel feed rate. If multiple waste feed rates are evaluated, two successive days of testing will be scheduled for each of the proposed feed rates. The test schedule is indicated in the test matrix, Table A-1.

TABLE B-1 TEST MATRIX

Sample	Source	Container	Species Analyzed	Number (Maximum)
Florisil resin	PCB train	Amber glass	PCBs	5
Condensed water impinged particulates	PCB train impingers	Amber glass	PCBs	5
Train wash	D.I.G. hexane D.I.G. acetone	Amber glass	PCBs	5
Florisil blank		Amber glass	PCB background	1
Train wash blank		Amber glass	PCB background	1
Waste fuel	Trickle value (integrated)	Amber glass	PCB	4
No. 6 fuel	Trickle value (integrated)	Amber glass	PCB	1
Polyurethane plug	High-vol sampler	Amber glass	PCB's	8

In order to provide background data on emissions from the boiler, a preliminary test will be conducted with No. 6 fuel oil prior to the initiation of the PCB test burn. This test will be for the same duration and at the same conditions as those to be used for the PCB sampling. The test will use a PCB train and will provide emissions data for the boiler as operated at normal load and firing No. 6 fuel oil. A measurement of the precision of stack collection of PCB will be provided by the simultaneous operation of duplicate PCB trains on the second day of the burn.

Boiler and Stack Gas Parameter Measurements

During each of the tests, boiler operational parameters will be as indicated in Table A-2. Continuous monitoring of flue gas for CO, CO_2, and O_2 will be provided. The monitors will be equipped with a gas conditioning system and recorders. Monitors will be calibrated prior to use and as required. Parameters will be continuously recorded during each test.

Other flue gas parameters will also be measured including the flue gas velocity, static pressure and temperature. These measurements will be made prior to each run for the determination of proper nozzle size and sampling rate. These are also shown in Table A-2.

Table B-2 SUPPORTING PARAMETER MEASUREMENTS DURING TEST

Parameter measured	Method
CO_2 in flue gas	Continuous gas analyzer
CO in flue gas	Continuous gas analyzer
O_2 in flue gas	Continuous gas analyzer
Flue gas velocity	Calibrated pitot tube/manometer
Flue gas temperature	Thermocouple
Flue gas pressure	Pitot tube/manometer
Percent moisture in flue gas	Moisture gain in Method 5 tests
Fuel flow rate	Positive displacement or differential pressure flowmeter

Sampling Requirements

The stack sampling program will require approximately four days of testing with four team members on site. A total of three to four tests and one background test will be conducted. Other requirements to be provided include the following:

- three 20 amp circuits accessible to stack;
- three 20 amp circuits for monitors;
- area for sample recovery.

Quality Control

In order to prevent any contamination of samples with materials which may interfere with analysis, the highest level of quality control will be observed in all field testing. All solvents and resins will be checked for purity before the sampling program; filter paper and glass wool will be solvent-cleaned. Appropriate blanks will be included to provide background information. The sampling trains will be all glass and precleaned to remove any residues. At no time will plastics or grease be used on the organic sample portions of the sampling train. Sample packing lists will be included for each test with information regarding source lot numbers and preservation/extraction techniques.

Each PCB train will be spiked in the field with a solution containing a known amount of deuterated tetrachlorobiphenyl internal standard. Laboratory analysis of the internal standard will provide information on sampling and analysis efficiency.

AMBIENT MONITORING

Sampling Method and Schedule

Sampling will be with high-volume samplers, modified as described in "A Method for Sampling and Analysis of Polychlorinated Biphenyls (PCBs) in Ambient Air," EPA-600/4-78-048 (Figure A-1). The airborne PCB is collected on a series of two precleaned polyurethane foam plugs housed in the sampler throat, a 16-cm long threaded, aluminum tube. Motor exhaust is diverted from the sampler intake by a duct. Flow rate through the sampler will be maintained at between 20 and 35 ft^3/min for a sampling period time coordinated with the verification test.

Wind directions expected to prevail during the test period will be used to select two nearby downwind sites. Positioning of the two on-site downwind monitors will be done each morning prior to the start of the sampling period. This will be done on the basis of forecast weather, on-site wind conditions, and expected plume dispersal.

ANALYTICAL METHODOLOGY

Stack Sampling

The following procedures apply after sample recovery in the field. A prescreening analysis will be used, requiring perchlorination of PCBs with antimony pentachloride. This procedure converts all PCB isomers in a sample to a single isomeric species, decachlorobiphenyl (DCB). This approach can only be used for confirmatory purposes and to increase sensitivity. Because different amounts of DCB are produced by each isomer (mono-, bi-, tri-, etc.), adjustment factors are necessary to convert DCB values to specific Aroclor mixtures. Biphenyl, a known emission from combustion sources and present in Aroclor mixtures, is converted in the perchlorination process to DCB. Thus, if biphenyl is suspected to be present in significant amounts, it must be determined separately to correct DCB values. The exposed Florisil sorbent trap is extracted with hexane in a Soxhlet, cooled, and then concentrated to about 5 ml. Contents of the first two (water filled) impingers are extracted with hexane, dried by passing through columns filled with anhydrous Na_2SO_4, and added to the Florisil extract. The probe and impingers are rinsed with acetone then

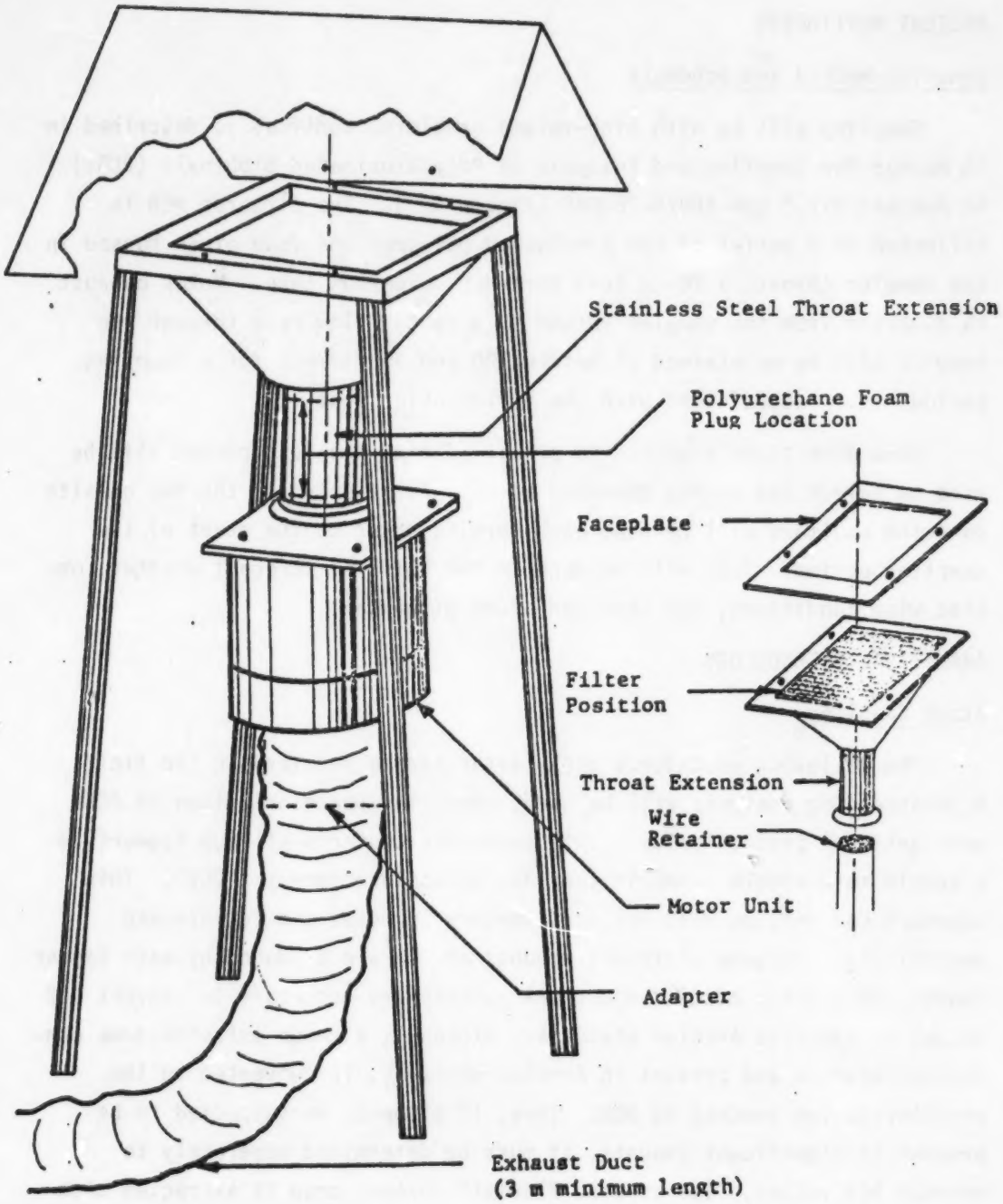


Figure B-1 Assembled sampler and shelter with exploded view of the filter holder.

hexane. The rinses are dried with anhydrous Na_2SO_4 and added to the combined extracts. The combined extracts are then cleaned by extracting with concentrated H_2SO_4 (if the cleaned extract is still colored, liquid chromatography on Florisil can be used). The extract is then made to 25 ml volume and split into four portions: three 5-ml volumes for perchlorination and one 10-ml aliquot for confirmation studies by GC/MS. After perchlorination, the solution is extracted four times with hexane and made to 5 ml. Analysis for decachlorobiphenyl is performed by GC-ECD. Chromatographic parameters are:

- Chromatograph - Any suitable instrument.
- Detector - Electron capture, ^{3}H or ^{63}N.
- Column - 1.8 m x 2 mm ID, 3% OV-210 on Supelcoport, 100/120 mesh.
- Temperatures - Column 280°C, others not specified.
- Carrier gas - Not specified (N_2 or H_2), 30 ml/min.
- Detection limit - Not specified, but standards of 25 to 50 pg/µl are suggested. The overall detection limit is specified as 10 ng DCB in a 5 ml perchlorination aliquot. This indicates a minimum detection limit of 2 pg/µl injected.

Results are reported in terms of ng DCB per cubic meter of combustion effluent sampled. GC/MS is used to verify the presence of PCBs by pattern matching with Aroclor mixtures. The precision of the DCB analysis is estimated to be 10-15%, and recovery of PCBs through the entire sampling and analysis procedure is estimated to be 85-95%.

Ambient Samples

Polyurethane foam plugs will be collected from ambient monitors and returned to the laboratory in precleaned amber glass jars with Teflon-lined caps. The samples will be Soxhlet extracted for 3 hours with hexane. After cooling, the extracts will be transferred to a Kuderna-Danish (K-D) evaporative concentrator and the volume reduced to 5 ml. The extract will then be divided into a reserve plus two portions for perchlorination according to the method outlined above.

APPENDIX C. EXAMPLE PUBLIC NOTICE

NOTICE OF INTENT TO CONDUCT VERIFICATION TEST OF PCB DESTRUCTION

1.0 BACKGROUND

A quantity of PCB-contaminated yellow grease, produced as a rendering byproduct, is currently stored at 2900 11th Avenue SE, Seattle, WA. The contaminated material, amounting to 1,100,000 lbs (150,000 gallons), is owned by Seattle Rendering Works, Seattle, WA. The PCB[1] content of the grease (116 to 391 ppm range) qualifies it for destruction in a high efficiency boiler or, alternatively, disposal in a chemical landfill under 40 CFR Part 761. The Regional Administrator of U. S. Environmental Protection Agency Region 10 will review the proposed destruction of the waste in a high-efficiency boiler to assure that the prerequisites of 40 CFR Part 761 are satisfied.

A high efficiency boiler has been selected by the owner for use in disposing of PCB - contaminated yellow grease. It is the U.S. EPA Regional Office intent to require a verification burn to demonstrate that PCB contaminated waste can be destroyed effectively.

(1) The boiler capacity is rated at 46 million Btu/hr heat input, as compared to the prerequisite 50 million Btu/hr.

(2) The recommended waste feed rate will be 100% waste as fuel, rather than the prerequisite of 10% waste with 90% normal fuel. Both full and half feed rates will be demonstrated.

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[1]The Condensed Chemical Dictionary, Van Nostrand Reinhold Company, 1977, page 696. "polychlorinated biphenyl (PCB). One of several aromatic compounds containing two benzene nuclei with two or more substituent chlorine atoms. They are highly toxic. Their chief use is in heat exchange and insulating fluids in closed systems. FDA has prohibited their use in plants manufacturing foods, animal feeds, and food-packaging materials, and has established strict tolerances on their presence in many food products (2.5 ppm).
NOTE: Because of their persistence and ecological damage from water pollution their manufacture has been discontinued in the U. S. (1976)."

1.1 OBJECTIVES OF THE VERIFICATION BURN

The purpose of this verification is to accurately measure the destruction efficiency of the designated high efficiency boiler for PCB, using the recommended operating conditions. The test results are expected to reveal minimum destruction efficiencies of greater than 99.9 percent based on other test results in related equipment. If the destruction efficiency is confirmed at greater than 99.9%, confidence will then exist that the unit can destroy the PCB waste, consistent with the intent of 40 CFR Part 761. This will then serve to support the operational disposal of all the contaminated stocks by the owner.

2.0 DESCRIPTION OF PROPOSED TEST FACILITY

2.1 EXISTING FACILITY

It is proposed that the waste grease containing PCB will be incinerated in the process steam boiler at Seattle Rendering Works, located at 5795 S. 130th Place, Seattle, WA. The boiler at Seattle Rendering is a dual-fuel (gas and/or #6 oil) watertube Cleaver-Brooks model (Delta D-60) with a design capacity of 35,000 lbs steam/hr. The oil burner is a low-pressure, air atomizing type. The rated gas-fuel efficiency is 78%, so the design heat input is 46,000,000 Btu/hr. The furnace volume is 755 cu. ft. in the immediate combustion zone, excluding the upper radiant section. Typical stack temperatures at maximum firing are 550-560 F. The combustion zone temperatures are in excess of 2200 F at the back wall.

The boiler has the standard set of safety controls, including a programmed burner shut-down in the event of flame failure; low water conditions; low fuel oil temperature; low fuel oil pressure; low atomizing air pressure; or excess steam pressure.

Facilities for storage of yellow grease at Seattle Rendering include two 270,000 lb capacity heated storage tanks. The grease is pumpable at about 100 F, and congeals at lower temperatures. Other storage and transport equipment includes two 50,000 lb insulated trailers, and one 20,000 lb insulated trailer.

2.2 REQUIRED MODIFICATIONS TO THE EXISTING FACILITIES

The normal oil-feed supply to the boiler will be blocked off, and a temporary waste fuel line installed. The temporary line will run from a grease storage trailer to the fuel feed pump of the boiler with a circulating return line. The trailer and transfer lines will be dedicated during the verification burn.

Additional measurement points that will be installed for adequate boiler monitoring during PCB incineration include:

(1) Flowrate indicator and recorder downstream of oil regulating valve.

(2) Air windbox pressure indicator.

(3) Continuous carbon monoxide and excess oxyger monitoring in the flue gas.

2.3 OPERATIONAL REQUIREMENTS

The Seattle Rendering boiler normally operates at full modulation from a low fire to high fire position, regulated by steam pressure. Since the PCB destruction verification burn will be required to operate at a steady rate of waste fuel consumption, process steam generation will be held constant during the test period.

The following table compares the proposed verification test conditions with boiler and operating condisitons presented in 40 CFR Part 761.

EPA Requirement (Federal Register 40 CFR Part 761)	Proposed Verification Test
1. Boiler must be rated at a minimum of 50 MM BTU per hour.	1. 46 MM BTU/hour rating
2. Oil flow containing PCB's must be less than 10% of the total fuel flow.	2. 100 % contaminated fuel.
3. Oil containing PCB must not be added during startup and shutdown.	3. Same (gas-firing will be used)
4. Before burning PCB contaminated oil, the owner/operator must conduct tests and determine that the combustion emissions contain at least 3% excess oxygen and no more than 50 parts per million of carbon monoxide.	4. Same

5. The company must notify the appropriate EPA Regional Administrator at least 30 days prior to the test and has supplied the combustion emissions data required in No. 4.	5. Emissions will be determined for proper combustion prior to verification burn.
6. The combustion process is monitored continuously or, for boilers burning less than 30,000 gallons of mineral oil annually, at least once each hour that PCB contaminated oil is being burned.	6. The combustion process will be monitored continuously for all boilers.
7. The primary fuel and mineral oil feed rates are monitored at least every 15 minutes whenever PCB contaminated mineral oil is being burned.	7. The fuel feed rates will be monitored continuously for all boilers.
8. The carbon monoxide and excess oxygen levels are checked at least every 15 minutes whenever burning PCB contaminated mineral oil.	8. Proposed burn will require CO, CO_2. Excess O_2 and opacity levels to be monitored continuously.

3.0 TECHNICAL SUITABILITY OF CONDUCTING THE VERIFICATION BURN

3.1 FUEL CHARACTERISTICS

The laboratory inspection of grease samples indicated below indicate that the contaminated waste can be burned as a boiler fuel substitute for No. 6 fuel oil, with good combustion characteristics.

1) The viscosity is between that of #5 and #6 fuel oil, so atomization should be good with a burner that is usually run with #6 oil.
2) The fuel value of the grease is 93% of a #6 oil value.
3) The ash content is low.

3.2 SUITABILITY OF THE BOILER

The waste fuel will be fired at full rate (6 gallons/minute) and half/rate (3 gallons/minute). The residence time of PCB and temperature in the furnace combustion zone are as follows:

Fuel Rate(gallons/minute)	Temperature (°F)	Residence Time (sec)
3	2200 (with supplementary gas firing)	2.2
6	2200	1.1

The residence time of PCB's and temperature for 3 gallons/minute firing rate are similar to those specified for commercial waste incinerators as called out in 40 CFR, Part 761, Subpart E (2191°F at 2 seconds).

3.3 SUITABILITY OF THE TEST PLAN

Normally, three separate tests are conducted at the same conditions for verification of the efficiency of PCB waste incineration. The verification burn performance at multiple grease feedrates is needed to decide on recommended operating conditions. Therefore, the verification test plan will be:

(1) Duplicate tests at 3 GPM feedrate.
(2) Duplicate tests at 6 GPM feedrate.

The boiler will be started up on natural gas fuel to reach steady operations, as determined by stack measurements of temperature, CO, and O_2. The grease circulation loop will then be started. When the feed temperature reaches 140-150°F, the grease fuel will be directed to the burner and the

gas fuel gradually reduced, such that stack temperatures and steam pressure remains constant.

The emissions tests during the verification burn will be carried out according to (an EPA-approved) test manual. The test procedure will use an integrated sampling train with a solid adsorbent that is effective in capturing PCB's in low concentrations. The sampling will be conducted isokinetically, with the sample probe positioned at a number of prespecified points during the traverse of the boiler stack. The sampling effort is expected to take 3 hours to get sufficient PCB capture for analysis detection. The adsorbent material and impinger rinses will be sealed and taken to a laboratory that is experienced in PCB analysis. Both gas chromatography (GC) and gas chromatograph mass spectrometry (GC/MS) analysis methods will be used.

4.0 ENVRIONMENTAL SUITABILITY OF CONDUCTING THE VERIFICATION BURN

The Air Quality analysis results were obtained for worst-case conditions as well as expected performance. The worst case analysis is based on an absolute failure mode (0% destruction of PCB contaminants, with waste concentrations higher than reported analyses and maximum waste fuel feed rate). The expected performance mode is based on 99.9% PCB destruction. and average PCB concentrations in the waste with mid-range feed rate of waste fuel.

Dispersion model estimates, using local terrain and meteorological data, predict a maximum downwind concentration of PCB of 16,000 nanograms per cubic meter (ng/m^3) for worst case conditions, and 4 nanaograms per cubic meter for expected performance. This can be compared to the OSHA standard limit value for PCB's. The OSHA allowable for worker exposure on an 8-hour day, 40-hour week basis is 1 million ng/m^3, so that worst-case conditions would produce a concentration about 60 times lower than industrial health standards. Absolute failure would only be caused by combustion failure, which would be detected and corrected if it happened during a verification burn.

The vicinity of the Seattle Rendering plant is mixed industrial-commercial-residential. The nearest residential areas are immediately west of the

plant (about 100 meters), and about 400 meters north, on a bluff approximately 50 meters high. The maximum downwind concentrations are predicted to occur in the prevailing wind direction, at the bluff 400 meters north from the plant. Ambient monitoring of PCB concentrations at these nearby residential areas will be carried out during the verification burn.

No significant water or land contamination is expected from the verification burn.

FUEL SAMPLING

Fuel samples will also be obtained and analyzed for PCBs, and the following parameters: N, S, Cl, C, H, ash, water, sediment, and caloric value. The fuel samples will consist of:

- A trickle sample obtained during each run
- A sample of No. 6 oil normally used in the boiler